CLIC forward region simulation status report

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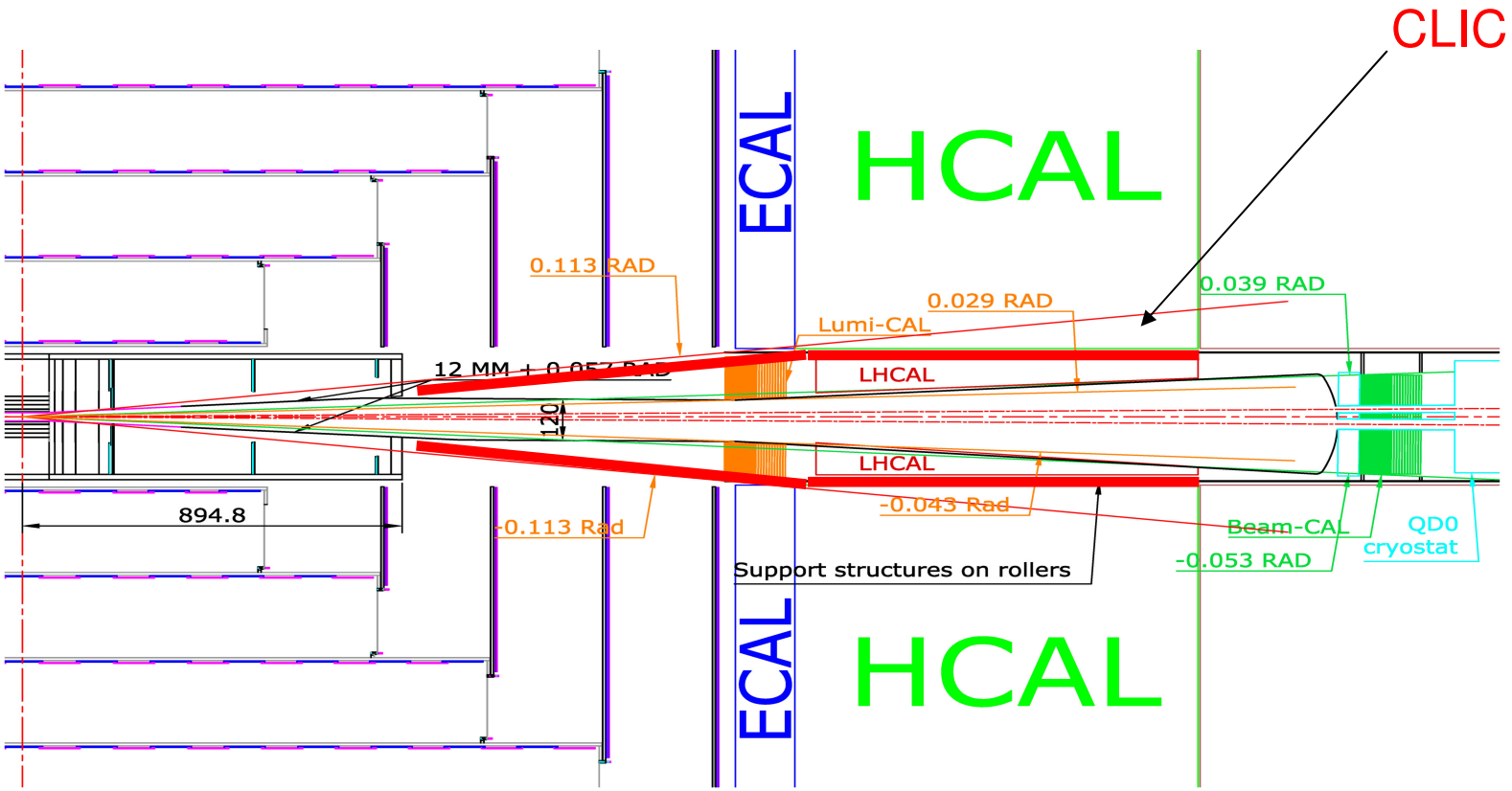
- Motivation
- Geant4 model of CLIC forward region
- Geometry description
- Preliminary background studies
- Summary

use SID design for CLIC detector:

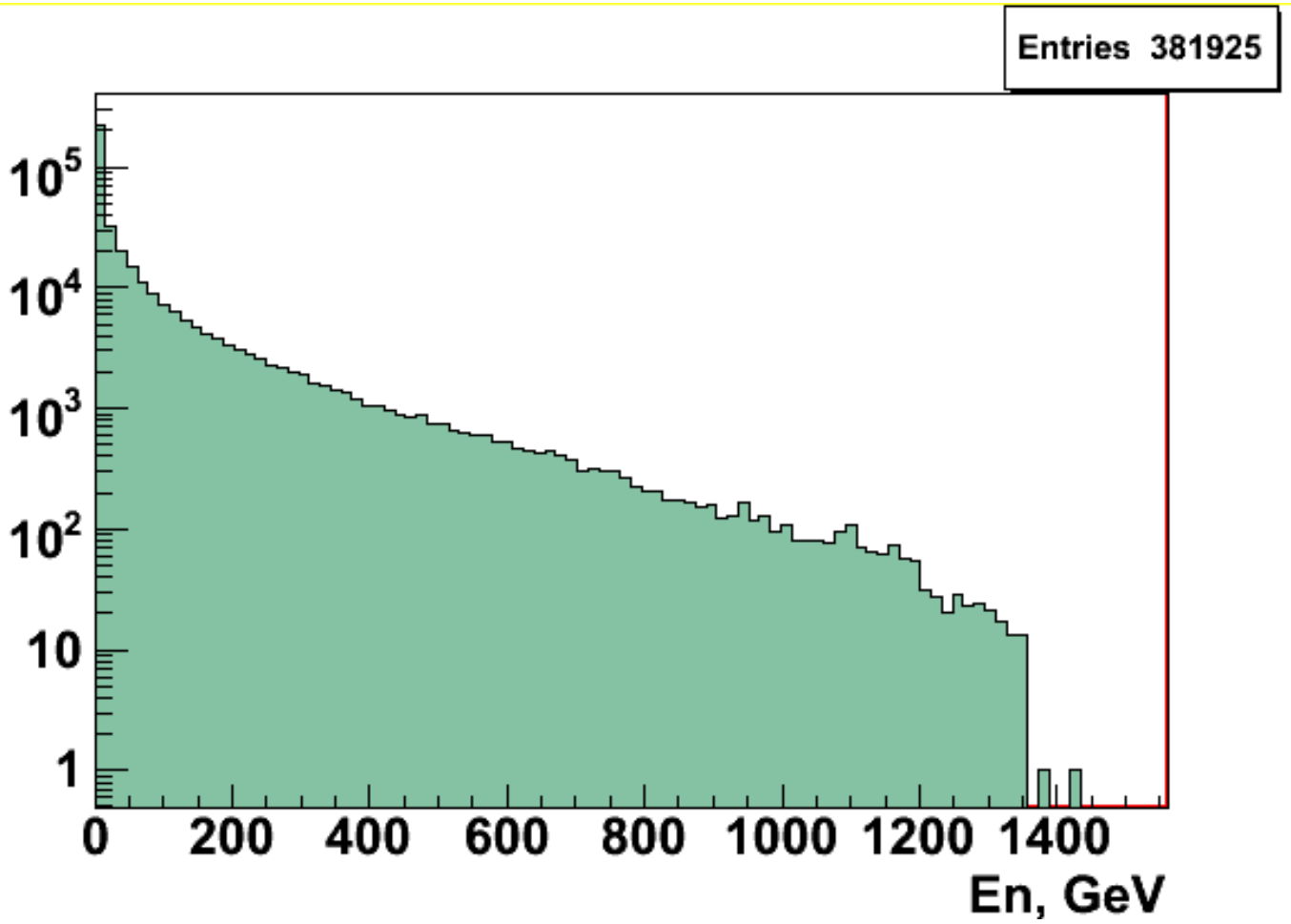


Due to high levels of backscattered beamstrahlung background one should design a mask to protect tracker and calorimeters.

- Simulate the forward region
- Perform background estimation
- Optimize the mask parameters for effective shielding

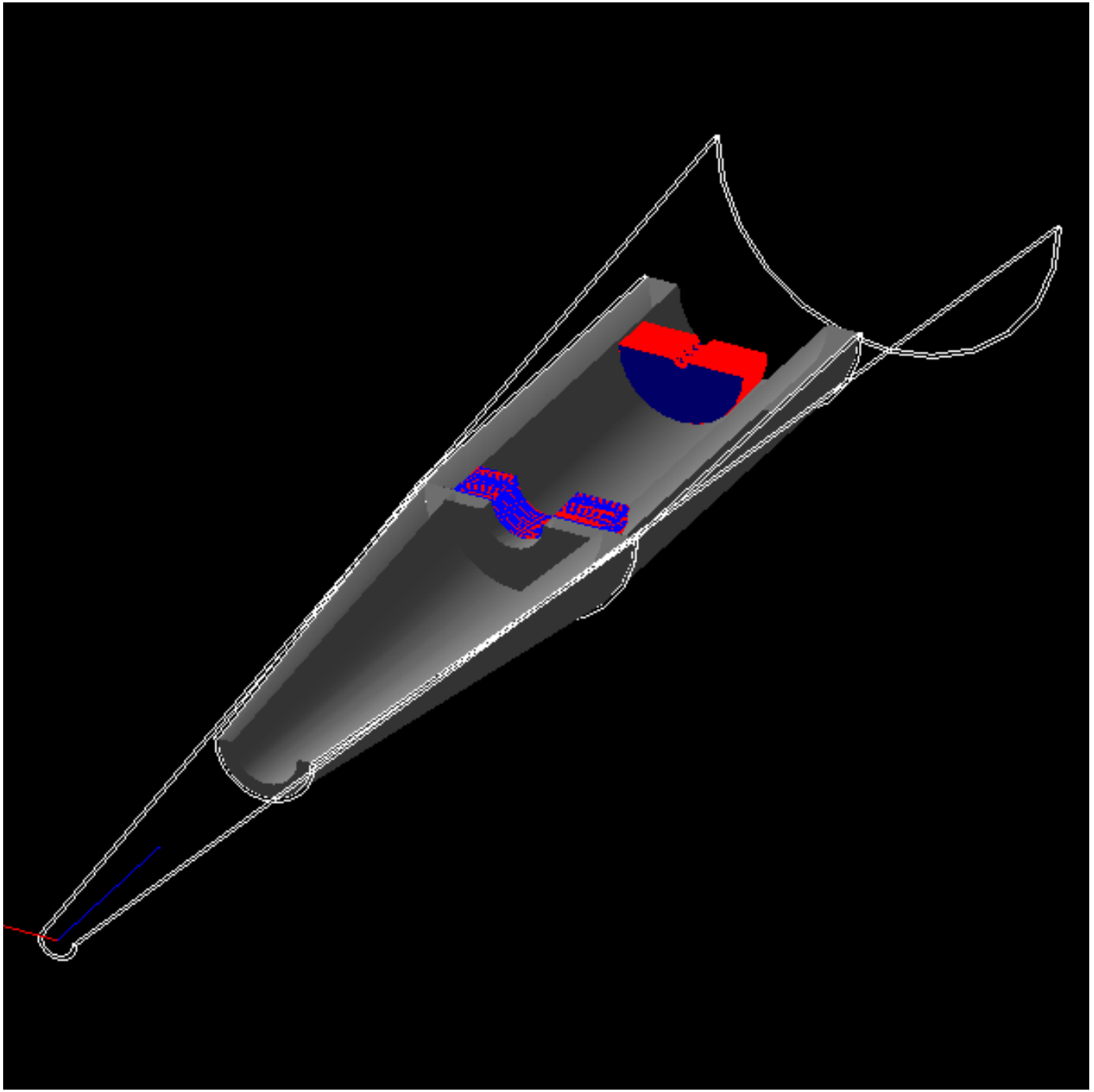
The dangerous background are mainly the backscattered photons, e+- and neutrons. They are produced from the e+- pairs compound of the beamstrahlung which collide with forward region detectors.

Beamstrahlung pairs energy distribution



Simulation:
Geant4.9.0p01

Physics list:
QGSP_BERT_HP
(quark-gluon string precompound, Bertini cascade, high precision)

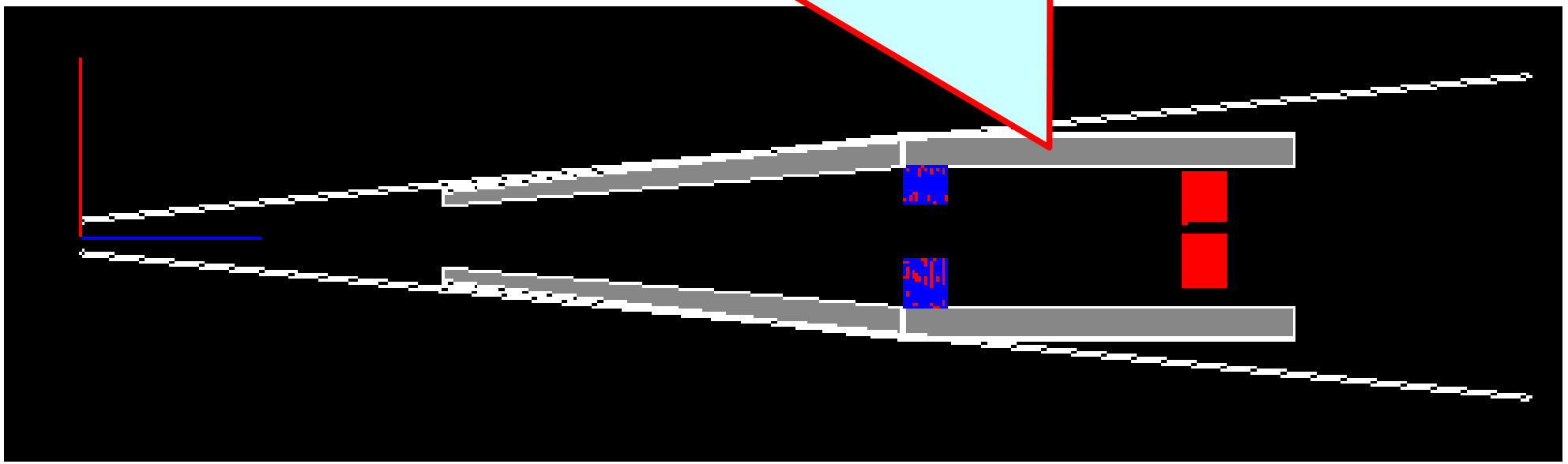


Geometry:

- Defined in config file
- Variable crossing angle
- Several magnetic field options: solenoid, (anti)DiD, fieldmap (so far only ILC format)

Mask parameters

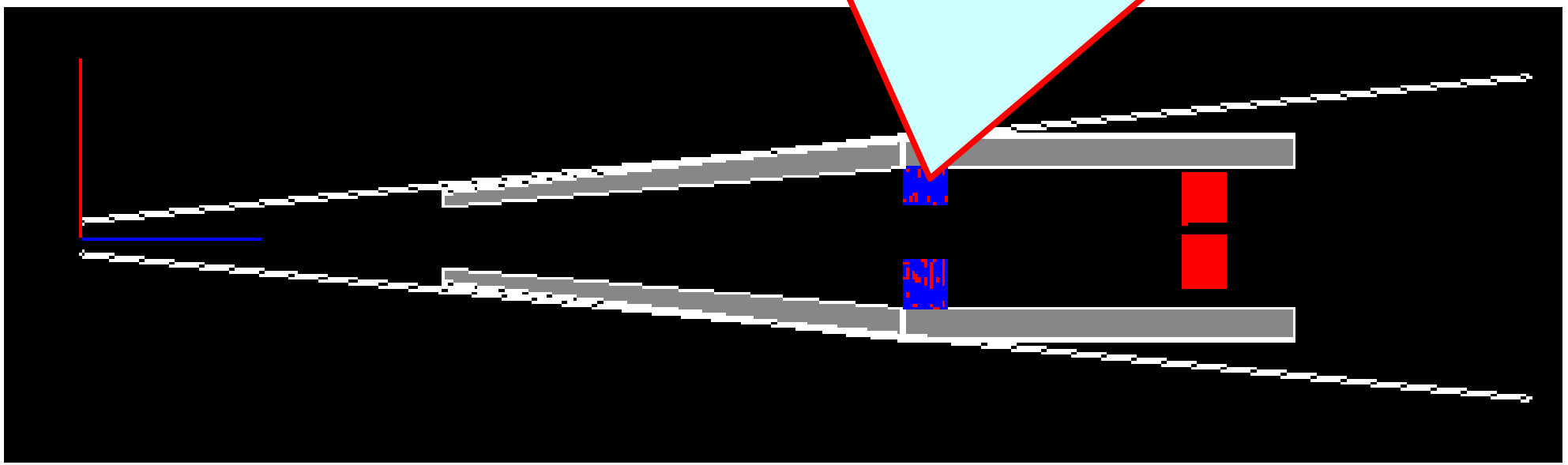
- **aligned to z (detector) axis**
- **starting point, z_start 1000 mm**
- **joint position, z_joint 2270 mm**
- **end point, z_end 3350 mm**
- **inner angle, theta_i 85 mrad**
- **outer angle, theta_m 120 mrad**
- **material: tungsten + polyethylene coating**



Geometry:

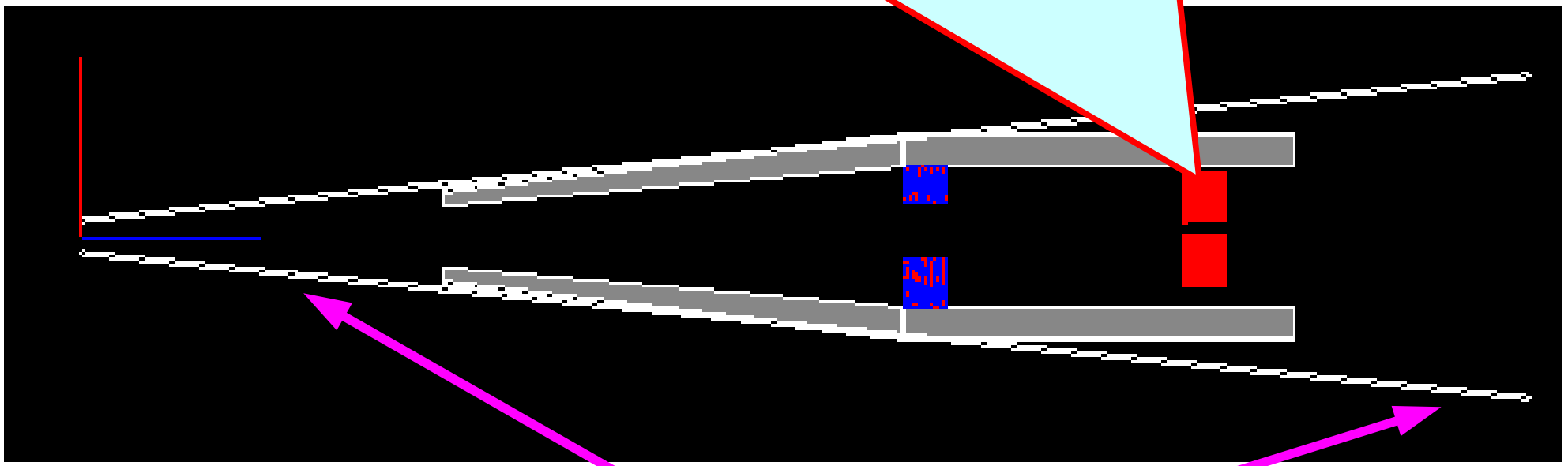
LumiCal parameters

- aligned to outgoing beam axis
- 5cm of graphite in front
- number of layers n_lrs 30
- inner radius, r_inner 80 mm
- outer radius, r_outer limited by mask
- absorber thkns, d_abs 3.5 mm
- sensor thkns, d_sens 0.5 mm
- material: tungsten / silicon



Geometry:
BeamCal parameters

- **aligned to outgoing beam axis**
- **number of layers, n_lrs 30**
- **distance from ip, z_pos 3100 mm**
- **inner radius, r_inner 20 mm**
- **outer radius, r_outer 160 mm**
- **absorber thkns, d_abs 3.5 mm**
- **sensor thkns, d_sens 0.5 mm**
- **material: tungsten / diamond**

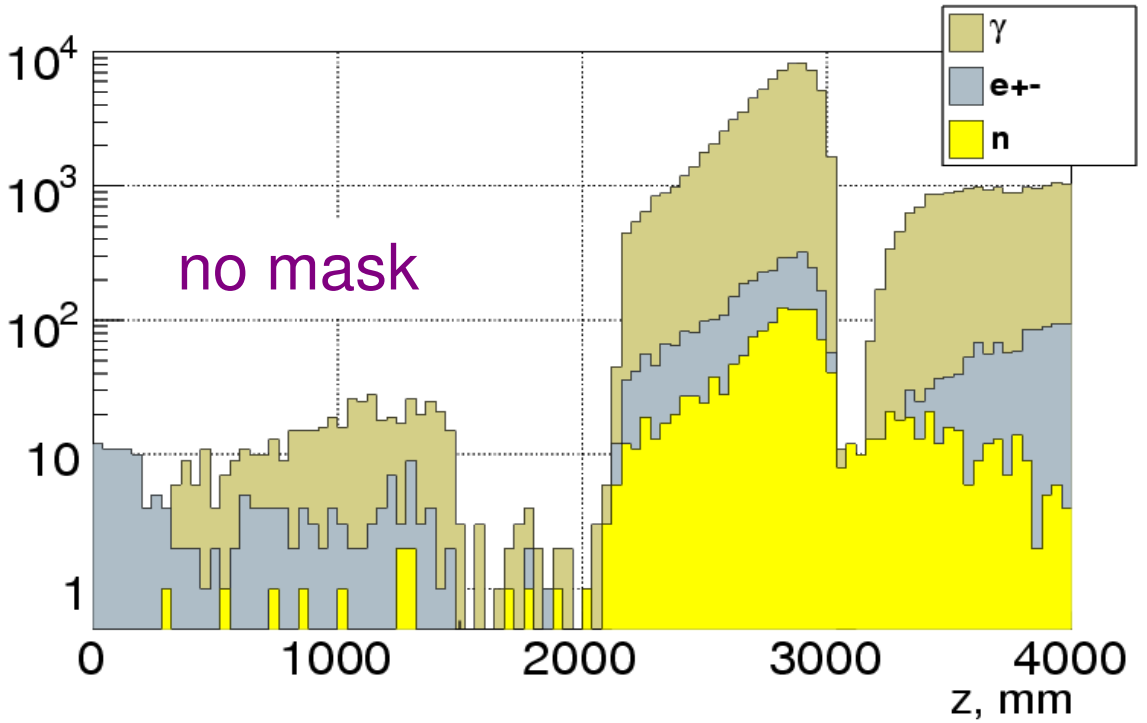


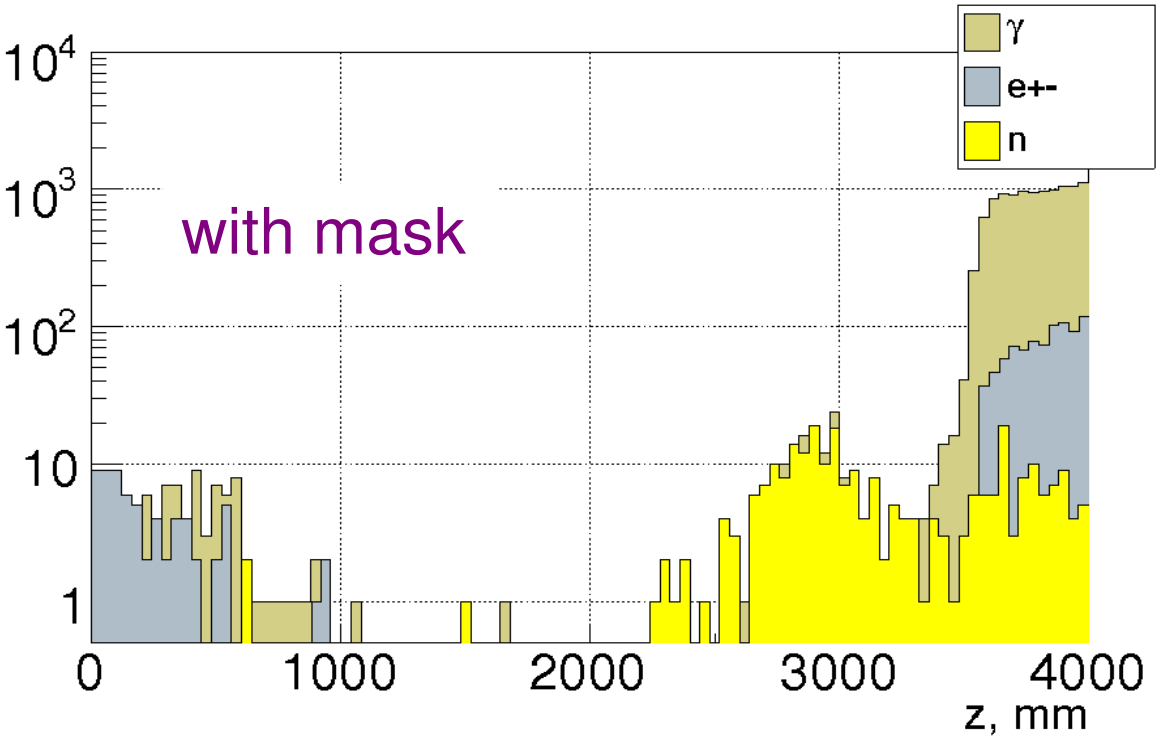
+ dummy volume to catch the particles directed to tracker and calorimeter endcaps

Preliminary background studies:

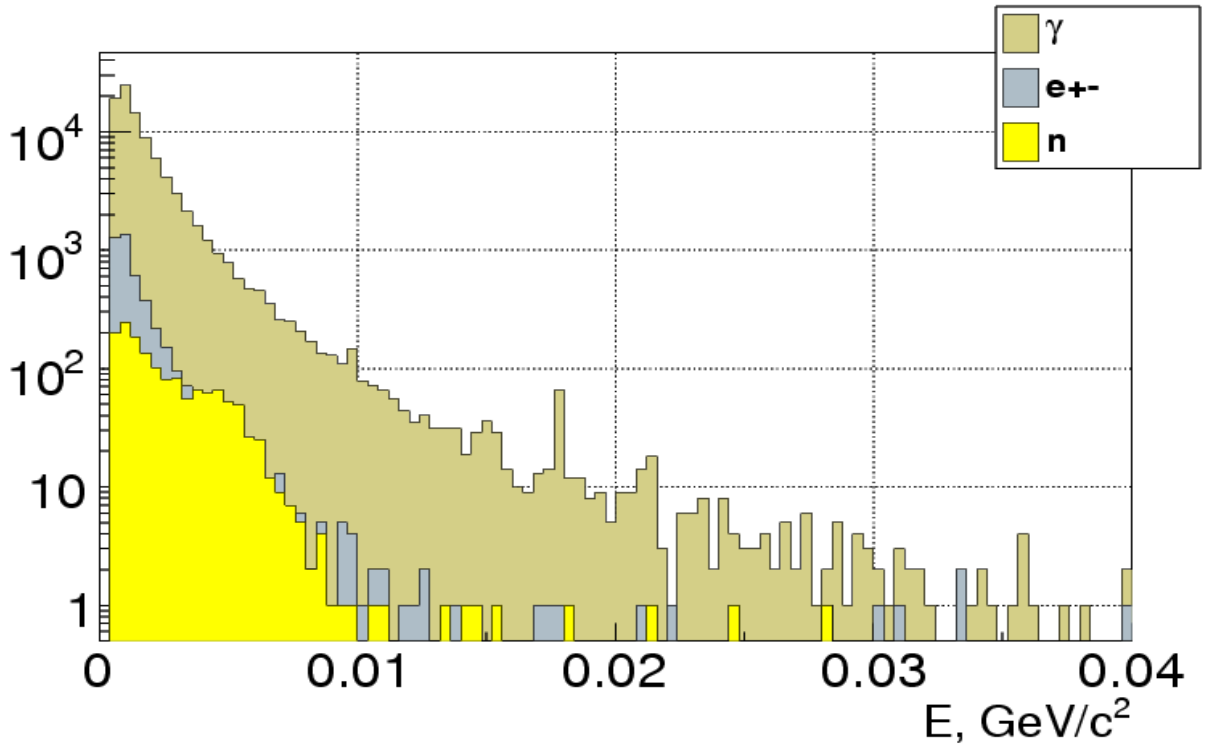
mask effectiveness,

spatial distribution of background hits in the dummy volume:

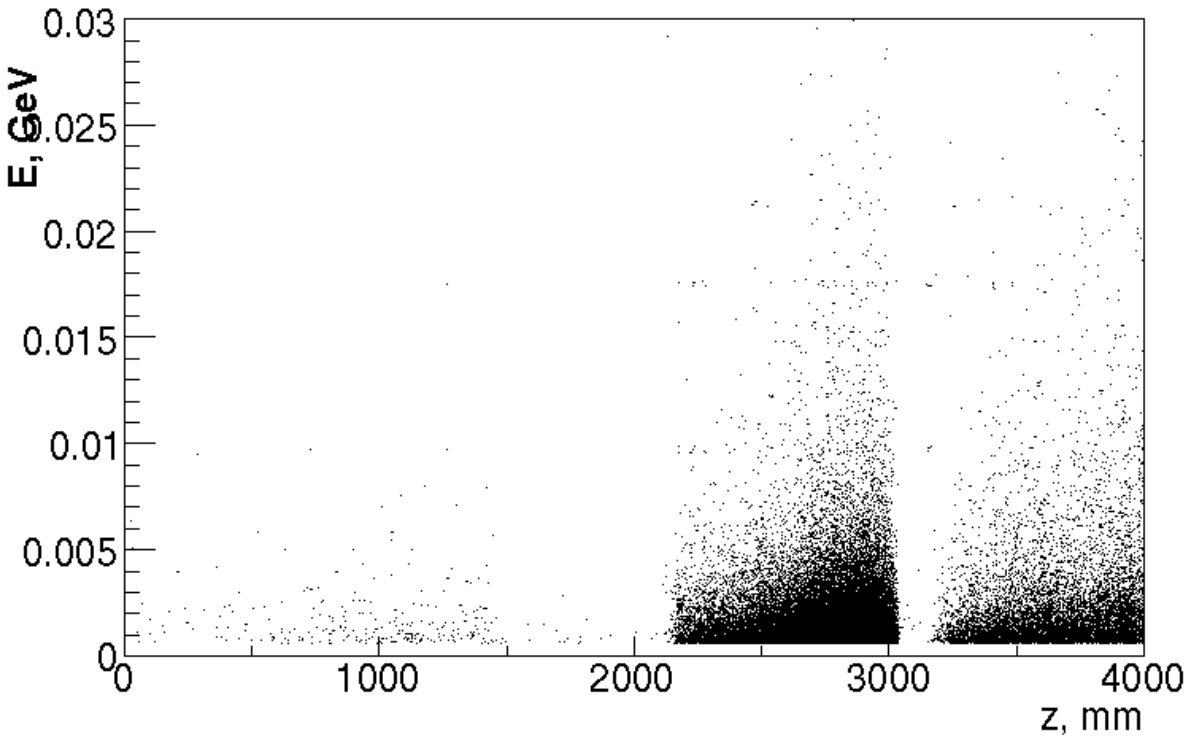




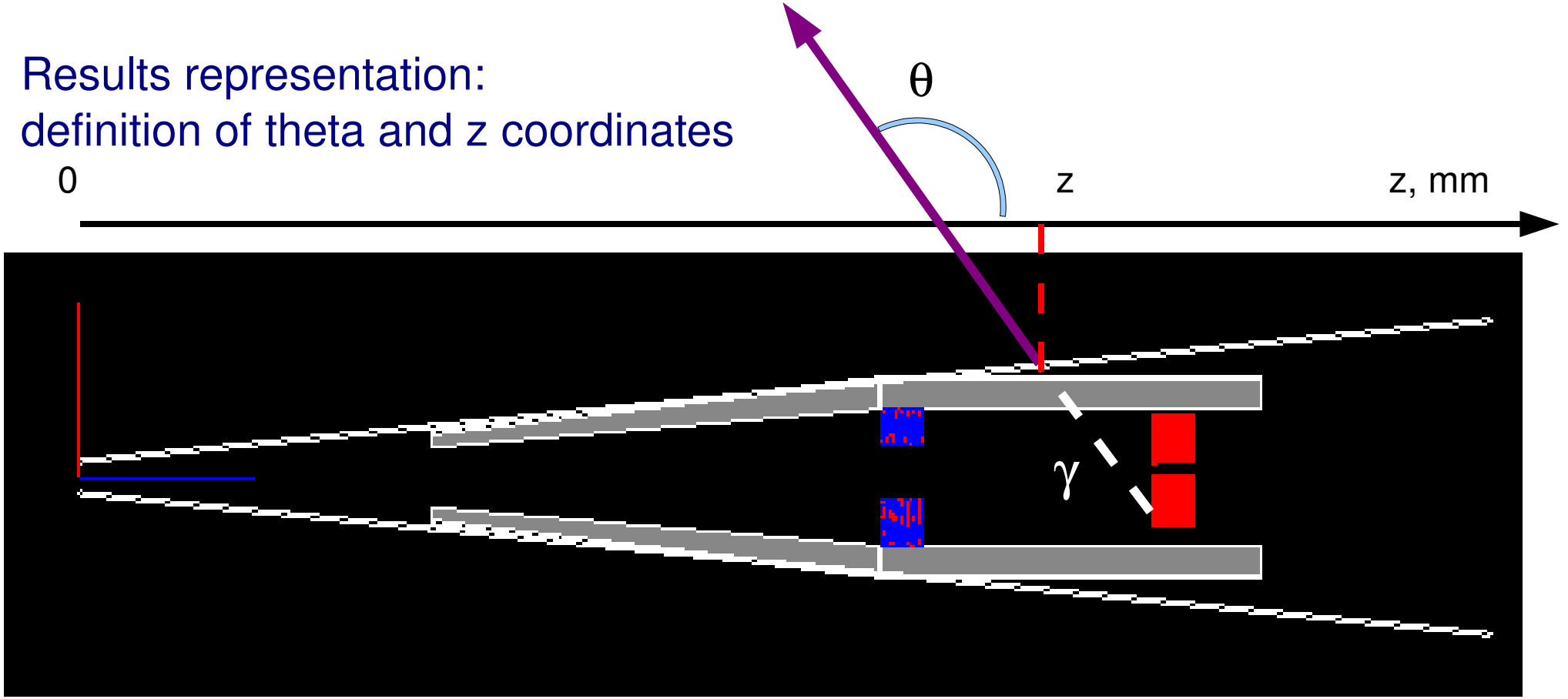
background energy spectrum



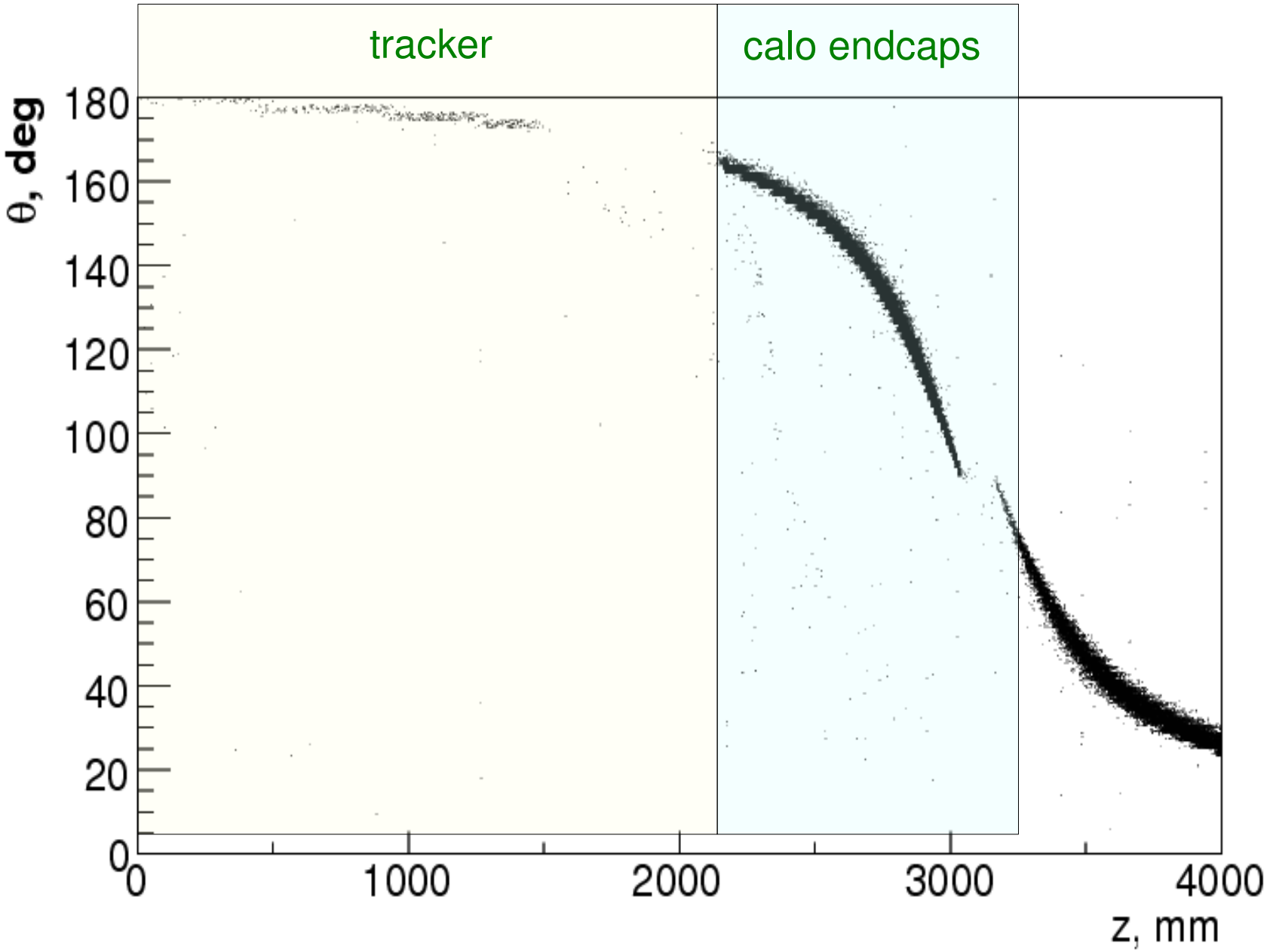
Energy vs z scatterplot for photons (no mask)



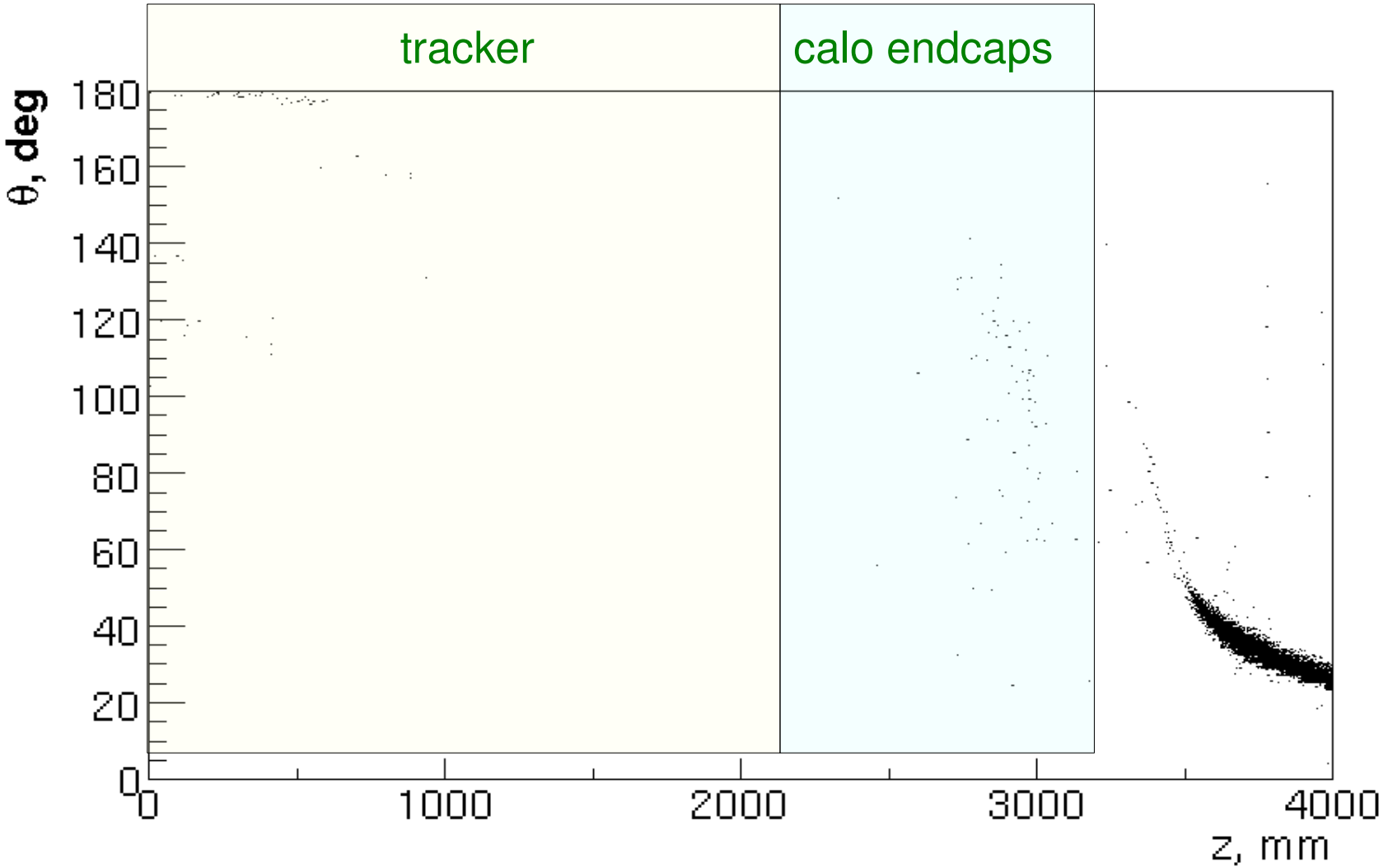
Results representation:
definition of theta and z coordinates



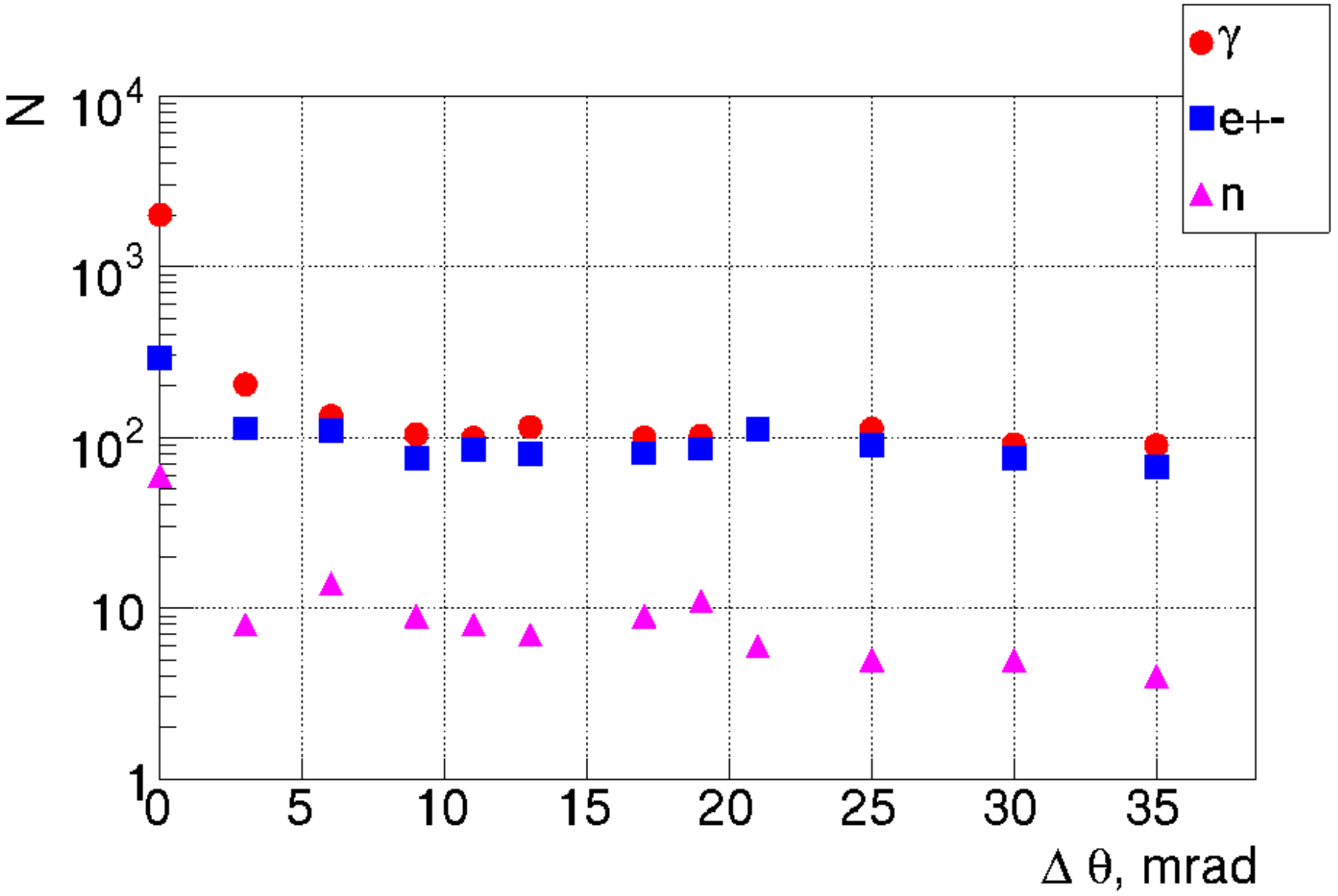
Theta-z scatterplot for photons no mask



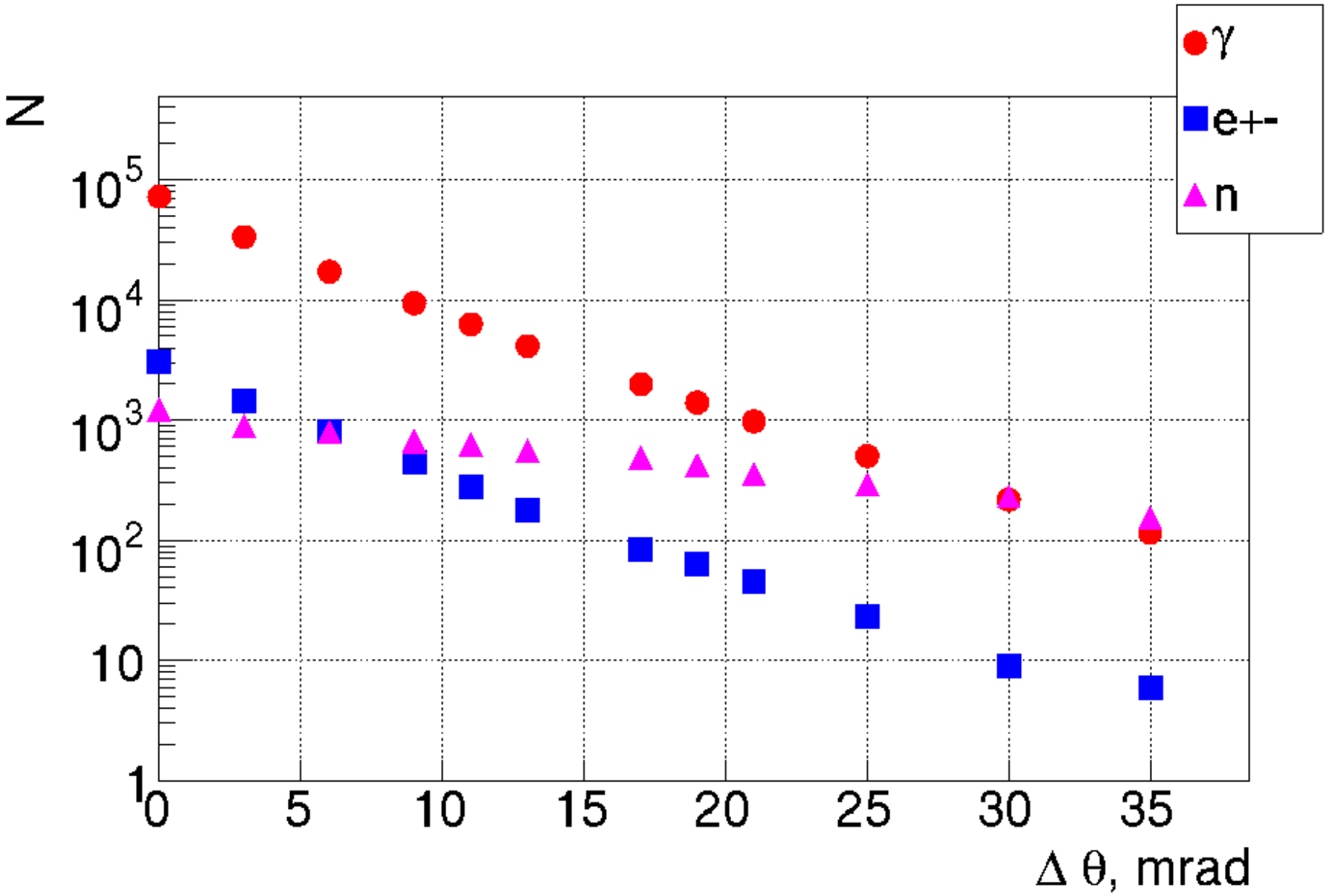
Theta-z scatterplot for photons with mask



Number of particles going to tracker depending on the mask opening angle ($\Delta\theta = \theta_{out} - \theta_{in}$)



Number of particles going to calorimeter.



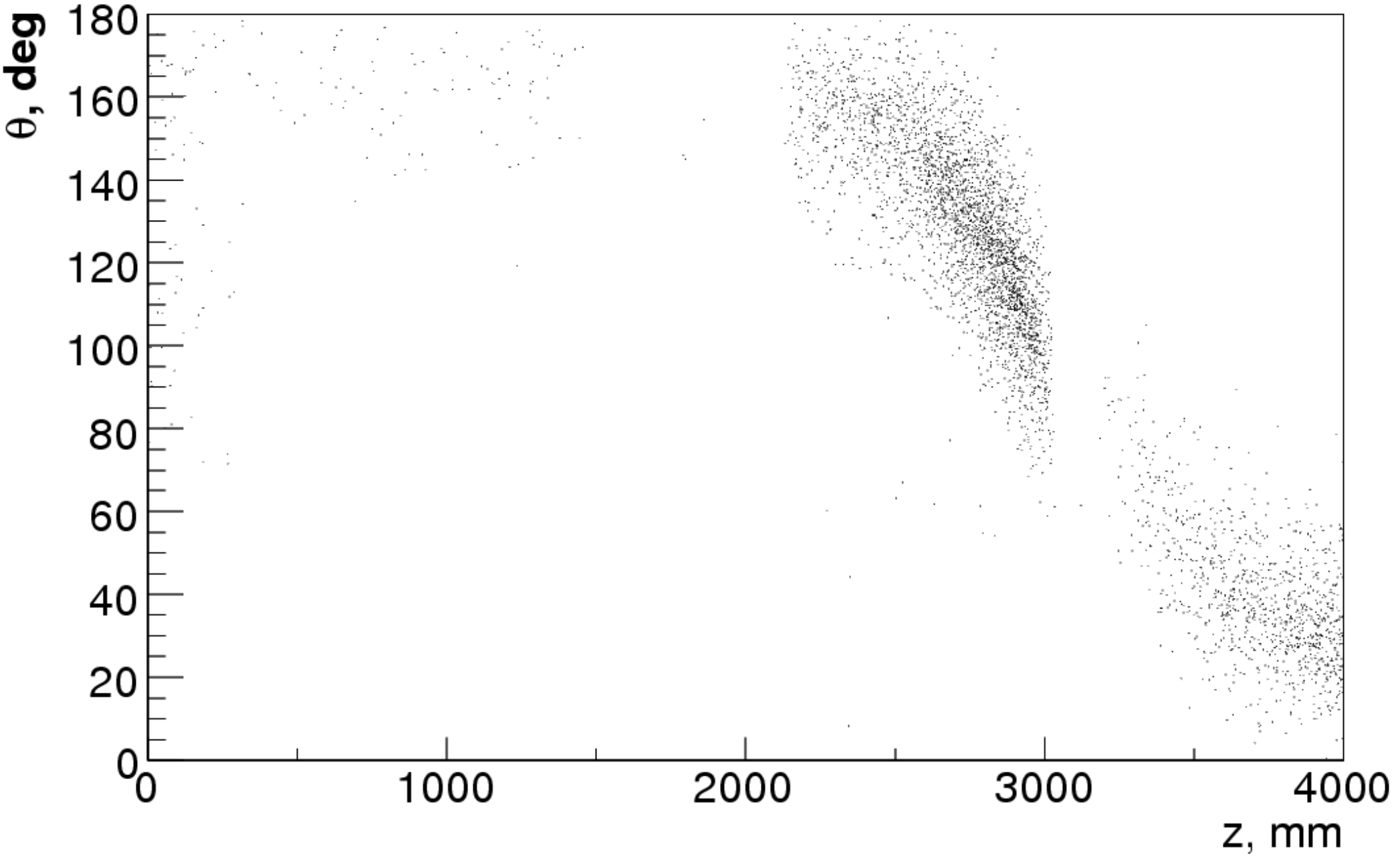
Summary

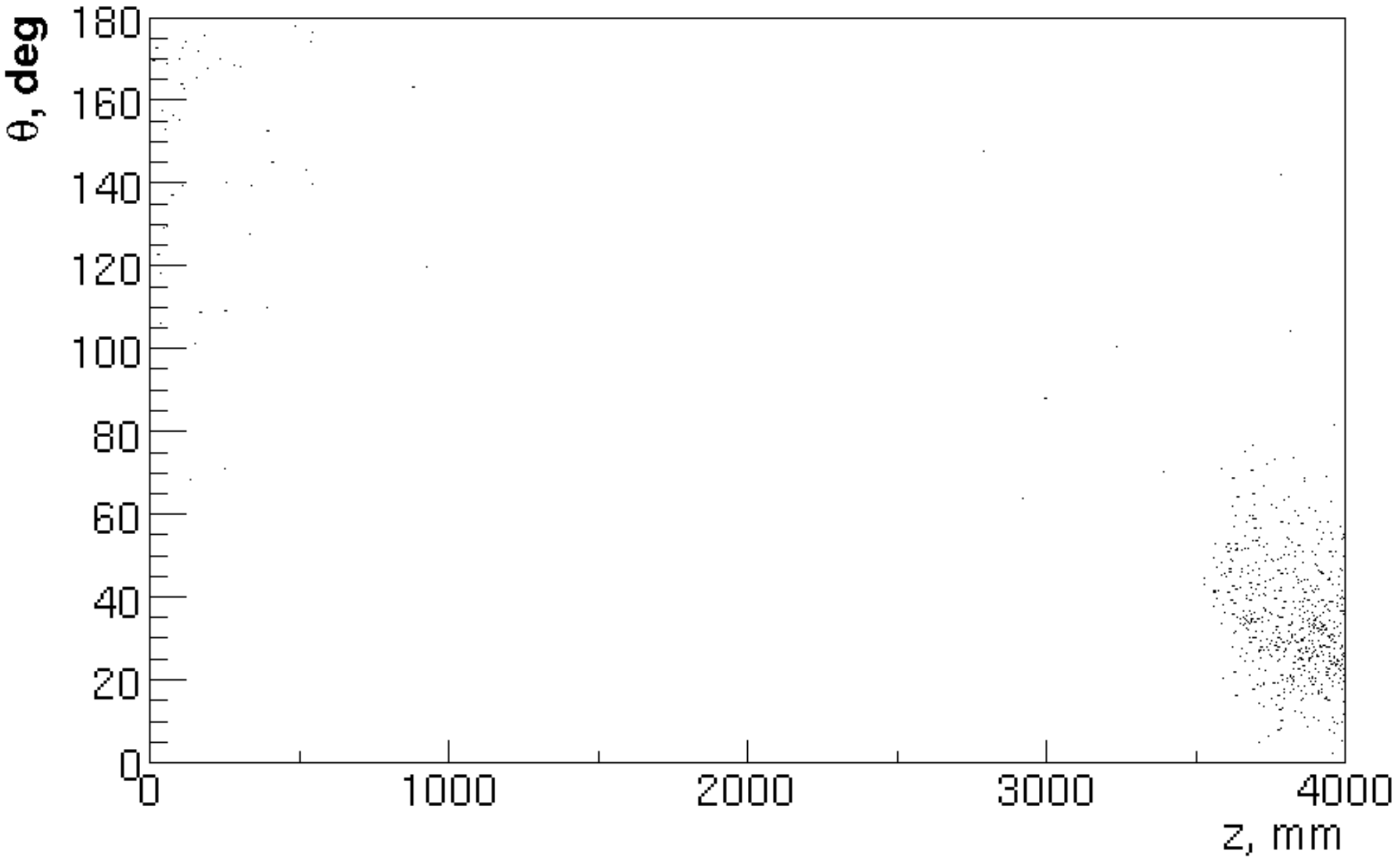
- Geant4 simulation for forward region of the CLIC detector was set up
- It can be configured with relatively variable geometry settings
- Preliminary background estimates was made:
- The main tracker background goes through the mask opening, the rest can be stopped with much less material than intended.
- The EM compound of the BG in calorimeters may be reduced relatively well, whereas the neutron shielding is not as effective.

To do:

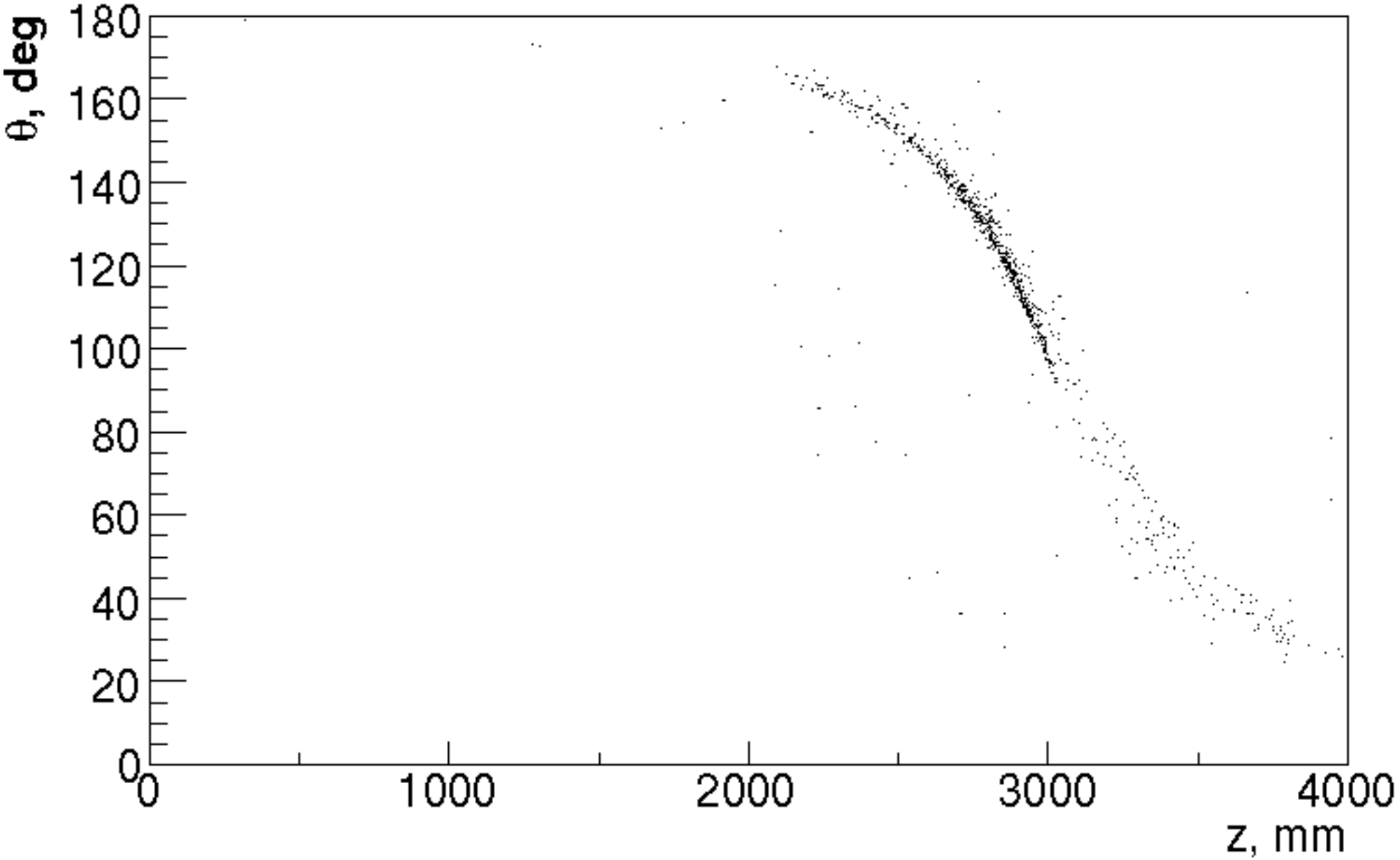
- More studies are needed with the other physics lists (simple changes of the code, but there are some problems with Geant4 documentation – hard to find out what one should use)
- Tests with polyethylene coating of the mask to shield from the neutrons more effectively
- Write documentation so anybody can use and/or modify the code

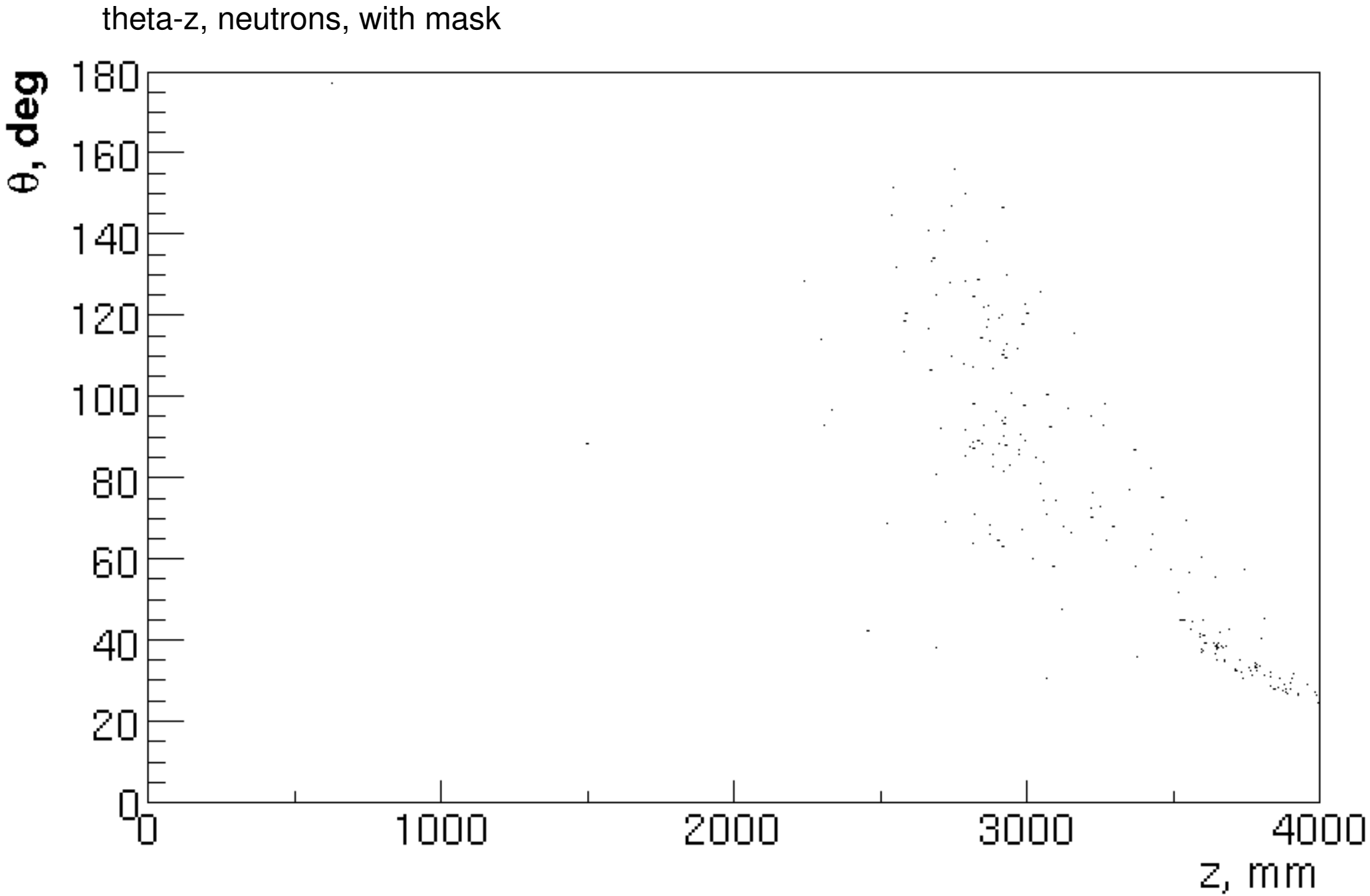
theta-z, electrons, no mask




theta-z, electrons, with mask
θ, deg
180
160
140
120
100
80
60
40
20
0
0
1000
2000
3000
4000
z, mm

theta-z, neutrons, no mask




theta-z, neutrons, with mask
θ, deg
180
160
140
120
100
80
60
40
20
0
0
1000
2000
3000
4000
z, mm